

Seat No.	
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**[5667]-101**

**F.E. EXAMINATION, 2019**  
**ENGINEERING MATHEMATICS—II**  
**(2015 PATTERN)**

**Time : Two Hours****Maximum Marks : 50****N.B. :—**

- (i) Attempt Q. No. 1 or Q. No. 2, Q. No. 3 or Q. No. 4, Q. No. 5 or Q. No. 6, Q. No. 7 or Q. No. 8.
- (ii) Neat diagrams must be drawn wherever necessary.
- (iii) Figures to the right indicate full marks.
- (iv) Use of electronic pocket calculator is allowed.
- (v) Assume suitable data, if necessary.

**1. (a)** Solve the following differential equations :

(i)  $(1 + \log xy)dx + \left(1 + \frac{x}{y}\right)dy = 0$  [4]

(ii)  $x^4 \cdot \frac{dy}{dx} + x^3 y - \sec(xy) = 0$  [4]

- (b) A long hollow pipe has an inner diameter of 10 cm and outer diameter of 20 cm. The inner surface is kept at 200°C and the outer surface at 50°C. The thermal conductivity is 0.12. Find the temperature at a distance 7.5 cm from the centre of the pipe. [4]

Or

**2. (a)** Solve  $3y^2 \frac{dy}{dx} + 2xy^3 = 4xe^{-x^2}$  [4]

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- (b) (i) A body at temperature 100°C is placed in a room whose temperature is 20°C and cools to 60°C in 5 minutes. Find its temperature after a further interval of 3 minutes. [4]

- (ii) A resistance of 100 ohms, an inductance of 0.5 henry are connected in a series with a battery of 20 volts. Find the current in the circuit if  $i = 0$  at  $t = 0$ . [4]

- 3. (a)** Obtain the Fourier series expansion of  $f(x) = x^3$ ,  $-\pi < x < \pi$ . [4]

- (b) Evaluate  $\int_0^\infty \sqrt{y} e^{-\sqrt{y}} dy$ . [3]

- (c) Trace the following curve (any one) [4]

(i)  $y^2(2a - x) = x^3$ .

(ii)  $r = a \cos 3\theta$

Or

- 4. (a)** If  $I_n = \int_{\pi/4}^{\pi/2} \cot^n \theta d\theta$ , prove that :

$$I_n = \frac{1}{n-1} - I_{n-2}$$
 [4]

- (b) Prove that  $\int_0^x \frac{e^{-ax} - e^{-bx}}{x} dx = \log\left(\frac{b}{a}\right)$  [4]

- (c) Find the length of upper arc of one loop of lamniscate  $r^2 = a^2 \cos 2\theta$  [4]

- 5. (a)** Find the centre and radius of the circle of intersection of the sphere  $x^2 + y^2 + z^2 - 2y - 4z - 11 = 0$  by the plane  $x + 2y + 2z = 15$ . [5]

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- (b) Find the equation of right circular cone which has its vertex at the point  $(0, 0, 10)$  and whose intersection with the plane XOY is a circle of diameter 10. [4]
- (c) Find the equation of right circular cylinder whose axis is  $x = 2y = -z$  and radius is 4. [4]

Or

6. (a) Find the equation of sphere through the circle  $x^2 + y^2 + z^2 = 1$ ,  $2x + 3y + 4z = 5$  and which intersects the sphere  $x^2 + y^2 + z^2 + 3(x - y + z) - 56 = 0$  orthogonally. [5]
- (b) Find the equation of right circular cone which passes through the point  $(2, -2, 1)$  with vertex at the  $(0, 0, 0)$  and axis parallel to the line  $\frac{x-2}{5} = \frac{y-1}{1} = \frac{z+2}{1}$ . [4]

- (c) Find the equation of right circular cylinder of radius 2 whose axis passes through  $(1, 2, 3)$  and has direction cosines proportional to 2, -3, 6. [4]

7. Attempt any two of the following :

- (a) Evaluate by changing the order of integration :

$$\int_0^1 \int_0^{\sqrt{1-y^2}} \frac{\cos^{-1} x \, dx \, dy}{\sqrt{(1-x^2-y^2)(1-x^2)}} \quad [7]$$

- (b) Find the volume cut-off from the paraboloid  $x^2 + \frac{y^2}{4} + z = 1$  by the plane  $z = 0$ . [6]
- (c) Find the moment of inertia of one loop of Lemniscate  $r^2 = a^2 \cos 2\theta$  about initial line. [6]

Or  
8. Attempt any two of the following :

- (a) Find the area inside the circle  $r = a \sin \theta$  and outside the cardioid  $r = a(1 - \cos \theta)$ . [7]

- (b) Evaluate :

$$\iiint_V \frac{dx \, dy \, dz}{\sqrt{1-x^2-y^2-z^2}} \quad [6]$$

taken throughout the volume of the sphere  $x^2 + y^2 + z^2 = 1$  in the positive octant.

- (c) Find the centre of gravity of an area of the cardioid  $r = a(1 + \cos \theta)$  [6]